

AD-B190 784 TEST OF T14 FEED MECHANISMS FOR 20MM GUN AN-M2(U) ARMY 1/1
AIR FORCES WASHINGTON DC 23 NOV 43 XA-AAF

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PROOF DEPARTMENT
ARMY AIR FORCES PROVING GROUND COMMAND
EGLIN FIELD, FLORIDA

1. APG File 2641
23 Nov 43

reg #877265
recd 3 Jul 56

FINAL REPORT

ON

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ELECTE
SEP 30 1994
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TEST OF T14 FIELD MECHANISMS FOR 20MM GUN AN-M2

Serial No.: 2-43-91 No. of Pages: 5 Date: 23 November 1943
AAF Board Project No. (M-5) 23

CLASSIFICATION CANCELED OR

CHANGED TO
AUTHORITY: 1st Reg Eglin 12/13

BY: B. B. B. B.
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DATE: 12/18/46

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APPROVED:

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Brigadier General, U.S. Army,
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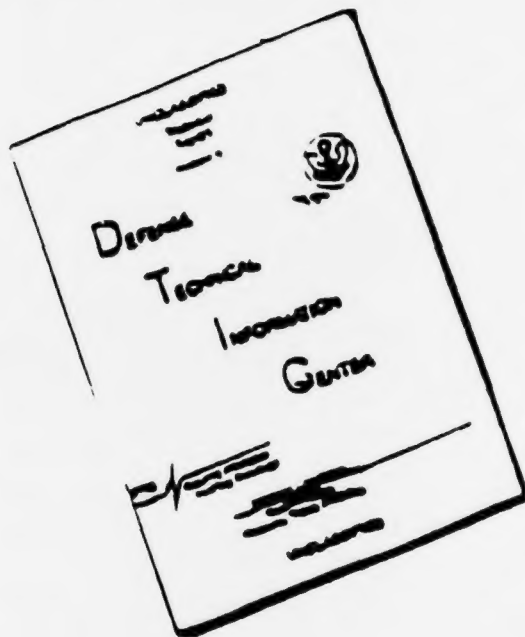
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1. OBJECT:

a. The primary purpose of this test is to conduct air firing tests of the TL4 feed mechanism as a basis for standardization.

b. The secondary purpose is to obtain data relative to the life expectancy of 20mm gun components and to obtain a general appraisal of the P-70 gun installation.

2. INTRODUCTION:

The test was requested in a letter from the Army Air Forces Materiel Command, Wright Field, Dayton, Ohio, dated 8 September 1943, to Commanding General, Army Air Forces Proving Ground Command, Eglin Field, Florida, subject: "TL4 Feed Mechanisms for 20mm Gun AN-M2." The test was begun 18 September 1943 and concluded 2 November 1943.

a. Description.

(1) The TL4 feed mechanism consists of a spring driven pair of sprockets mounted on a central shaft which forces the ammunition into the throat of the feeder, a free-wheeling drive mounted on the forward end of the shaft, a slipping clutch of improved design to prevent overwinding, link stripping cams located in the throat of the feeder, operating levers permitting winding of the feeder during both recoil and counter-recoil motions, and a supporting framework which attaches to the gun in the same manner as does the AN-M1 mechanism. (See Inclosures 7 and 8.)

(2) The feed mechanism may be initially wound at either the front or rear of the shaft, but it may be unwound only at the rear point. When wound at the front of the shaft, the slipping clutch is interposed between the driven shaft and the spring so that it is impossible to exert too much tension. When wound at the rear, however, the slipping clutch is short circuited and the operator will have to be experienced enough to know when he has applied the proper tension. The rear end of the shaft comprises a part of a positive clutch and in order to engage the clutch before the shaft is turned, it is necessary to press it inward toward the feed mechanism approximately 3/16".

(3) The design of the link is based on the requirement for stripping rounds directly from the link without any relative axial movement between the link and the round. To suit this requirement, the link is equipped with an extended ear protruding from each side of the double loop,

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which, when passing through the feed mechanism, is guided through stripping cams. The ammunition belt is assembled so that the top of the link is 3.80" from the base of the round. For the left or right-hand feed mechanism the belt is assembled so that the closed portion of the link enters at the top side of the feed mechanism, the single loop leading. No round is placed in the leading single loop, but a round is placed in the trailing double loop.

3. CONCLUSION.--It is concluded that:

The TL4 feed mechanisms for 20mm cannon AN-M2 (after modifications were made by the Oldsmobile representative, refer to paragraph 6 c) operated in an excellent manner in comparison to the AN-M1 feed mechanism.

4. RECOMMENDATIONS.--It is recommended that:

a. The subject TL4 feed mechanisms, as modified, be made standard equipment for 20mm cannon installations after the following additional changes have been made:

- (1) The door cover bracket be fastened more securely to the feed mechanism.
- (2) A thumb type spring latch be installed on the outside of the operating yoke.

5. RECORD OF TEST:

a. The test was conducted in accordance with the test program, which is attached as Inclosure 1, except that only about fifteen hundred (1500) rounds of A.P. ammunition were used, while the remainder expended was ball ammunition.

b. The airplane was flown under the various conditions as described in the test program with no apparent effect upon feeding.

c. Gun history charts are attached as Inclosure 2. The firing summary of the total missions are attached as Inclosure 3. The scores for the ground gunnery are attached as Inclosure 4. The component parts breakage record is attached as Inclosure 6.

6. DISCUSSION:

a. A summary of feeder stoppages for feeders tested at this station follows:

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C O N F I D E N T I A L

<u>Type of Feeder</u>	<u>Rds. Fired</u>	<u>No. of Stoppages</u>	<u>Rds/Storpage</u>
T-14 (final modification)	12,499	6	2,083
T-14 (before modification)	2,393	5	478
AN-M1	33,732	43	784
M1E1	7,944	16	496

b. Less time is required to train personnel properly to maintain the T14 feed mechanisms for 20mm cannon than is required for the AN-M1 feeders. The T14 feeders are open and expose all of the operating parts; breakages can be seen easily without taking the feeder apart. This type feeder will require less maintenance in actual field conditions. No oiling is necessary and the parts do not burr as easily as in the AN-M1 feeders. Burrs often make it necessary to take the AN-M1 feeders apart and stone the burred parts. The T14 feed is more easily and quickly taken apart and reassembled than the AN-M1 feeder. It is not necessary to take the T14 feeder apart as often as the AN-M1 feeder. The T14 feeders are smaller and easier to install. (See Inclosures 7 and 8.)

c. Upon arrival of the airplane at this station, the guns were checked and cleaned and five (5) missions were fired with rather poor results. After the first two (2) missions, the link ejection chutes were properly aligned to prevent link jams. After the fifth mission, the Oldsmobile representative took the feeders apart for a minute inspection and made the following changes:

- (1) The original free-wheeling drive units were replaced by new ones having the inner surface of the deep pocket shot-blasted. The shot-blasting pits the surface of the pocket, thus allowing the lubricant between the free-wheeling spring and pocket to escape during the drive portion of its cycle. This eliminates slippage.
- (2) The original link ejection deflectors were replaced by new ones designed to give better control and guidance to the link as it is being stripped from the round.
- (3) It was discovered that the link had been incorrectly positioned on the round due to misinformation. This mistake was corrected by placing the round 2-9/32" from the rear edge of the double loop to the base of the cartridge.

d. During the course of the test, one (1) door cover bracket broke off from the feeder due to a poor job of spot-welding. This condition can be corrected by fastening this bracket by a heavier weld or a rivet. (See Inclosure 5.)

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e. A thumb type spring latch should be installed on the outside of the yoke to prevent the operating lever of the feeder from coming out of the yoke and causing a gun stoppage. This stoppage occurred four (4) times on one (1) feeder, due to a weak plunger spring unlatching while firing.

f. In this installation the link ejection chutes were not aligned properly and caused link jams on several of the first missions. This condition was corrected by aligning these chutes properly with the guns.

7. INCLOSURES:

- Inclosure 1 - Test Program.
- Inclosure 2 - Gun History Charts.
- Inclosure 3 - Firing Summary.
- Inclosure 4 - Gun Scores.
- Inclosure 5 - Photographs.
- Inclosure 6 - Component Parts Breakage Record.
- Inclosure 7 - Photograph.
- Inclosure 8 - Photograph.

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C O N F I D E N T I A L

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Prepared by:

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PROOF DEPARTMENT
ARMY AIR FORCES PROVING GROUND COMMAND
EGLIN FIELD, FLORIDA

24 September 1943

SUBJECT: Program for Test of TL4 Feed Mechanisms for 20mm Gun AN-M4.
(S.T. No. 2-43-91)

TO: Commanding Officer, 1st Proving Ground Group, AAFFGC,
Eglin Field, Florida.

1. GENERAL:

a. Description of the TL4 Feed Mechanism.

- (1) The TL4 feed mechanism consists of a spring driven pair of sprockets mounted on a central shaft which forces the ammunition into the throat of the feed, a free-wheeling drive mounted on the forward end of the shaft, a slipping clutch of improved design to prevent overwinding, link stripping cams located in the throat of the feed, operating levers permitting winding of the feed during both recoil and counter-recoil motions, and a supporting framework which attaches to the gun in the same manner as does the AN-M1 mechanism.
- (2) The feed mechanism may be initially wound at either the front or rear of the shaft, but it may be unwound only at the rear point. When wound at the front of the shaft, the slipping clutch is interposed between the driven shaft and the spring so that it is impossible to exert too much tension. When wound at the rear, however, the slipping clutch is short circuited and the operator will have to be experienced enough to know when he has applied the proper tension. The rear end of the shaft comprises a part of a positive clutch and in order to engage the clutch before the shaft is turned, it is necessary to press it inward towards the feed mechanism approximately 3/16".
- (3) The design of the link is based on the requirement for stripping rounds directly from the link without any relative axial movement between the link and the round. To suit this requirement, the link is equipped with an

Inclosure 1.

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extended ear protruding from each side of the double loop, which when passing through the feed mechanism, is guided through stripping cams. The ammunition belt is assembled so that the top of the link is 3.80" from the base of the round. For the left or right hand feed mechanism the belt is assembled so that the closed portion of the link enters at the top side of the feed mechanism, the single loop leading. No round is placed in the leading single loop, but a round is placed in the trailing double loop.

- (4) The mechanism weighs twelve (12) pounds, and occupies less space than the AN-M1 feed mechanism.
- (5) The winding energy for the feed is transmitted from the gun by means of a bracket assembly which is attached to the gun receiver and which operates an engaging lever protruding from the feed mechanism.
- (6) The feed is designed to operate on approximately 5/8" recoil. The design of the mechanism is such that in the event some of the original torque is lost, it cannot be regained, however, no torque will be lost unless the recoil drops below the required 5/8" travel.
- (7) A last round retainer device is incorporated which is similar to that provided in the AN-M1 feed mechanism.
- (8) Each front gun has two hundred (200) rounds and each rear gun three hundred (300) rounds of ammunition available.

b. This is a FIRST PRIORITY experimental service test.

c. Eight thousand (8,000) rounds of A.P. and eight thousand (8,000) rounds of ball 20mm ammunition are authorized for this test.

d. This test was requested in a letter from the AAF Materiel Command, Wright Field, Dayton, Ohio, to Commanding General, Army Air Forces Proving Ground Command, Eglin Field, Florida, subject: "T14 Feed Mechanisms for 20mm Gun AN-M2."

e. Captain John W. Waters is designated as the Machine Gun and Cannon Section Project Officer for this test.

f. 1st Lt. T. R. Iglesias is designated as the 1st Proving Ground Group, AAFFGC, Test Officer for this test.

g. At the conclusion of this test, which should be conducted for a period of fourteen (14) days, the subject airplane will be disposed of in accordance with existing regulations.

2. OBJECT:

a. The primary purpose of this test is to conduct air firing tests of the T14 feed mechanism as a basis for standardization.

b. The secondary purpose is to obtain data relative to the life expectancy of 20mm gun components and to obtain a general appraisal of the P-70 gun installation.

3. METHOD OF CONDUCTING TEST:

a. The four (4) guns will be fully loaded with A.P. ammunition and the airplane will be flown at a speed of two hundred forty (240) miles per hour and the guns will be fired out during level flight and at maximum accelerations.

b. The airplane will be flown as described in the above paragraph and the guns fired in the same manner but the guns will be fully loaded with A.P. and ball ammunition loaded one (1) to one (1).

c. The guns will be fully loaded with ball ammunition and the airplane will be flown as described in paragraph a and the guns will be fired out while the airplane is in steep glides.

d. The two (2) right guns will be fully loaded with ball ammunition while the two (2) left guns are fully loaded with A.P. ammunition. The airplane will be flown as described in paragraph a, and the guns will be fired out with a series of right and left banks.

e. The airplane will be flown with the guns fully loaded as described in paragraph d, and the guns will be fired out during a series of steep climbs.

f. The airplane will be flown and the guns fully loaded as described in paragraph d, and the guns will be fired out during severe pull-outs.

g. Any or all of the above missions will be repeated until malfunctions are reduced to a minimum and until at least four thousand (4,000) rounds are fired through each feeder.

4. RECORDS:

a. The armament member will load each gun so that a dummy round will be the third one from the end of the belt. A torque reading will be

taken at the start of the mission and also at the conclusion of each firing. Belts will be given the usual check for weak or binding links.

b. The armament member will keep gun histories showing the number of rounds fired, malfunctions, breakages, and hours of maintenance, paying particular attention to each and every component replacement.

c. Photographs will be taken by the Proof Department Photographer of the subject equipment and of any constructional failures that may occur.

5. REPORTS:

a. A daily progress report will be maintained by the Project Officer in the office of the Machine Gun and Cannon Section, Proof Department.

b. A final report will be prepared by the Project Officer, after a conference with all participating personnel, and submitted to the Chief of the Proof Department, through the Chiefs of the Testing Branch and Machine Gun and Cannon Section, immediately upon completion of the test.

By Command of Brigadier General GARDNER:

J. O. Guthrie

J. O. GUTHRIE,
Colonel, Air Corps,
Actg. Chief, Proof Department.

Prepared by:

J. W. Waters

J. W. WATERS,
Captain, Air Corps,
Project Officer.

Concurred in:

[Signature]

J. E. IGLESIAS,
1st Lt., Air Corps,
Group Test Officer.

Approved by:

[Signature]

W. A. SHEPPARD,
Major, Air Corps,
Chief, Machine Gun and
Cannon Section.

Approved by:

[Signature]

J. O. GUTHRIE,
Colonel, Air Corps,
Chief, Testing Branch.

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Airplane Type P-70 Airplane No. 39-736 S.F. # 2-43-91

Gun Type 20 MM Gun Serial No. 165610 Installation Left Outboard

Rounds Loaded	Rounds Fired	Total To Date	Date	Armors Initial	Type Amm. Let. No.	Remarks
						Previous rounds fired - 530
225	225	225	9/16	RHB	AP	OK. Torque not checked.
300	5	230	9/22	RHB	Ball	Action home-no round in chamber-broken driving spring-guns cleaned-
(Link chutes aligned in Sub-Depot)						
300	30	260	9/23	RHB	Ball	new type firing pins installed.
						Feed run down-mount loose-torque before mission 275#. after, 100#
						(inch #)
300	145	405	9/24	RHB	AP&Ball	Feeder run down-round in chamber but projectile damaged enough to prevent belt from going into battery position.
300	95	500	9/25	RHB	Ball	Feeder run down-failure to feed-torque before take-off 325#. after, 75#. Feeders had new free-wheeling unit installed. Guns cleaned and checked.
25	25	525	10/1	RHB	Ball	OK. Bore-sight range-checked recoil.
300	226	751	10/2	RHB	Ball	41 links in ammo, belt torque OK
300	294	1045	10/4	RHB	"	Link jam-round out of line in belt
300	300	1345	10/4	RHB	"	OK. Torque OK

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S. T. #

39-736 2-43-91

20 MM

165610

Left Outboard

300	300	1645	10/5	RHB	Ball	OK. Torque OK, guns cleaned and checked
300	300	1945	10/11	RHB	Ball	OK. Torque OK
300	300	2245	10/12	RHB	AP & Ball	OK. Torque OK, guns cleaned and checked, cracked breechblock lock replaced
300	300	2545	10/18	RFR	Ball	OK. Torque OK
300	300	2445	10/22	"	"	OK
300	45	2890	10/24	"	"	Separated belt (weak link)
300	136	3028	10/28	RHB	"	OK. Pilot stopped firing
300	5	3033	10/30	"	"	Link jam, bent prong on link
300	300	3333	10/30	"	"	OK
300	25	3350	10/30	"	"	Broken firing pin, broken firing pin parts, curved firing pin slot, bolt replaced.
300	300	3652	11/1	"	"	OK
300	300	3950	11/2	"	"	OK
300	300	4258	11/2	"	"	OK. Replaced gas cylinder vent plug

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70-100-1000

Mr. Tolson P-70 Airplane No. 39-736 S.T. # 2-43-91

20 NM

165616

Right Outboard

225	25	25	9/14	RHB	AP	Previous rounds fired - 530
300	115	170	9/22	"	Ball	Rounds out of line in belt
300	170	340	9/23	"	"	Link jam, link chute out of position. (Link chutes aligned in Sub-Depot) guns cleaned and checked. New type firing pins installed.
300	300	610	9/24	"	AP2 Ball	Insufficient recoil due to loose mount. Torque before mission 250%, after mission 150%.
300	25	665	9/25	"	Ball	Torque before mission 325%, after mission 150%.
25	25	630	10/1	"	"	Feeder had new free-wheeling unit installed and guns cleaned & checked.
300	300	990	10/2	"	"	Feeder run down, failure to feed.
300	300	1290	10/4	"	"	OK, Boresight range. Recoil checked.
300	300	1590	10/4	"	"	OK Torque OK
300	50	1840	10/5	"	"	OK Torque OK
300	255	1895	10/11	"	"	OK Torque OK
300	300	2195	10/12	"	AP2 Ball	Link jam. Link chute bent and was strengthened.
						Belt came apart inside ammunition can (weak link).
						OK Torque OK, guns cleaned and checked, cracked breechblock lock replaced.

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P-70 39-736 S.T. # 243-91

20 MM 165616 Right Outboard

300	300	2495	10/18	WTR	Ball	OK
300	118	2613	10/22	"	"	Failure to extract. Extractor spring broken and driving spring replaced.
300	300	2913	10/24	"	"	OK
300	138	3051	10/28	RHB	"	OK. Pilot stopped firing
300	300	3351	10/30	"	"	OK
300	300	3651	10/30	"	"	OK. replaced cracked breechblock lock, driving spring and rear buffer assembly. Retainer pin broken.
300	300	3951	10/30	"	"	OK
300	300	4251	11/1	"	"	OK
300	150	4401	11/2	"	"	Magazine slide securing arm screw broken
300	300	4701	11/2	"	"	OK, gas cylinder sleeve spring broken and replaced, installed new gas cylinder vent plug, changed burred ejector.

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Right Inboard

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165612

Right Inboard

Amount Paid	Round Fired	Total To Date	Amount Paid Initial	Date	Remarks
200	200	1863	10/22	OK	
200	200	2063	10/24	OK	
200	112	2130	10/28	OK, pilot stopped firing	
200	200	2330	10/30	OK	
200	200	2530	10/30	OK	
200	114	2694	10/30	Broken firing pin	
200	200	2894	11/1	OK	
200	25	2919	11/2	Safety wire on ejector studs broken. Ejector loose.	
200	200	3119	11/2	OK, new gas cylinder vent plug installed.	

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Installation	Left Inboard
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C O N F I D E N T I A L

Summary of Firing After
Modifications Accomplished
as described in paragraph 6 b

Total gun missions 64

Total gun missions fired out 41

Total stoppages 23

Total rounds loaded (1000 - A.P. & Ball
15500(14500 - Ball

Total rounds fired (720 - A.P. & Ball
12499(11779 - Ball

Percent rounds fired 80.6%

Total rounds not fired 3001

Percent rounds not fired 19.4%

Rounds not fired due to feeder 825

Percent rounds not fired due to feeder 5.3%

Rounds not fired due to gun 738

Percent not fired due to gun 4.7%

Rounds not fired due to ammunition 160

Percent not fired due to ammunition 1.1%

Rounds not fired due to maintenance & misc. . . 1278

Percent not fired due to maintenance & misc. 8.3%

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Number, Type and Rounds Not Fired Due To Stoppages

Feeder Stoppages

2 - Link jams 347
4 - Operating lever 478
out of yoke
6 825

Gun Stoppages

2 - Broken firing pin 361
2 - Failure to extract 227
1 - Broken magazine slide screw 150
5 738

Ammunition Stoppages

1 - Inert round 160

Maintenance & Miscellaneous Stoppages

3 - M-1 Link in belt 324
2 - Failure to align 9
2 - Weak link 300
1 - Broken belt 150
1 - Failure to safety ejector 175
1 - Bent link 295
1 - Burred round 25
11 1278

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Summary of Firing Before
Modifications Accomplished
as described in paragraph 6 b

Total gun missions. 20

Total gun missions fired out 6

Total stoppages 14

Total rounds loaded 4743 (943 - A.P.
(1000 - A.P. & Ball
(2800 - Ball

Total rounds fired 2393 (541 - A.P.
(733 - A.P. & Ball
(1119 - Ball

Percent rounds fired 50.1%

Total rounds not fired 2350

Percent rounds not fired 49.9%

Rounds not fired due to feeder 1070

Percent not fired due to feeder 22.6%

Rounds not fired due to gun 326

Percent not fired due to gun 6.9%

Rounds not fired due to ammunition 102

Percent not fired due to ammunition 2.2%

Rounds not fired due to maintenance & misc. 852

Percent not fired due to maintenence & misc. 18.2%

Number, Type and Rounds Not Fired Due to Stoppages

Feeder Stoppages

4 - Feeder run down	905
<u>1 - Link jam</u>	<u>165</u>
5	1070

Gun Stoppages

1 - Broken driving spring	295
<u>1 - Broken firing pin</u>	<u>31</u>
2	326

Ammunition Stoppages

1 - Light struck primer	102
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Maintenence & Miscellaneous Stoppages

3 - Failure to align	455
1 - Loose mount	130
1 - Weak link	112
<u>1 - Link chute out of position</u>	<u>155</u>
6	852

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COMPONENT PARTS BREAKAGE RECORD

	<u>Rounds Fired</u>	<u>Still Firing</u>	<u>Caused Stoppage</u>	<u>Did not cause stoppage</u>
<u>Left Outboard Gun #165610</u>				
Standard firing pin changed after	4258			X
1st replacement new type firing pin broke after	230			
2nd replacement new type firing pin	3128		X	
Original driving spring failed after	900	X		X
1st replacement driving spring fired	230		X	
Original breechblock lock cracked at	4028	X		X
1st replacement breechblock lock	2245			X
Original firing pin slot bolt failed at	2013 (not cracked)			X
	3358			X
<u>Right Outboard Gun # 165616</u>				
Standard firing pin changed after	4701			
1st replacement type firing pin fired	170			X
Original breechblock lock cracked after	4531	X		X
1st replacement breechblock lock cracked after	2195			X
2nd replacement breechblock lock fired	1456			X
Original driving spring broken after	1050 (not cracked)			X
1st replacement driving spring replaced after firing	2613			X
2nd replacement driving spring replaced after firing	1038			X
	1050	X		X

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	Rounds Fired	Still Firing	Caused Storage	Did not cause Storage
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Right Outboard Gun #165616 - Cont'd

Original extractor spring broken after	2613		X	
1st replacement extractor spring	2088	X		X
Original rear buffer assembly	3651			X
1st replacement rear buffer assembly	1050	X		X
Original retainer pin broken	3651			X
1st replacement retainer pin	1050	X		X
Original magazine slide securing arm screw broken after firing	4461		X	
1st replacement magazine slide securing arm screw	300	X		X
Original gas cylinder sleeve spring broken	4761			X

Right Inboard Gun #165612

Standard firing pin changed after firing	98			X
1st replacement new type firing pin fired	2592		X	
2nd replacement new type firing pin fired	425	X		X
Original breechblock lock cracked after	1471			X
1st replacement breechblock lock fired	1648	X		X

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	Rounds Fired	Still Firing	Caused Stoppage	Did not cause Stoppage

Left Inboard Gun #165615

Standard firing pin changed after firing

1st replacement new type firing pin fired

Original breechblock lock cracked after

1st replacement breechblock lock cracked after

2nd replacement breechblock lock fired

Replaced original extractor and extractor spring
after firing

1st replacement extractor and extractor spring fired

2862

207

2655

1615

856

391

2722

140

X

X

X

X

X

X

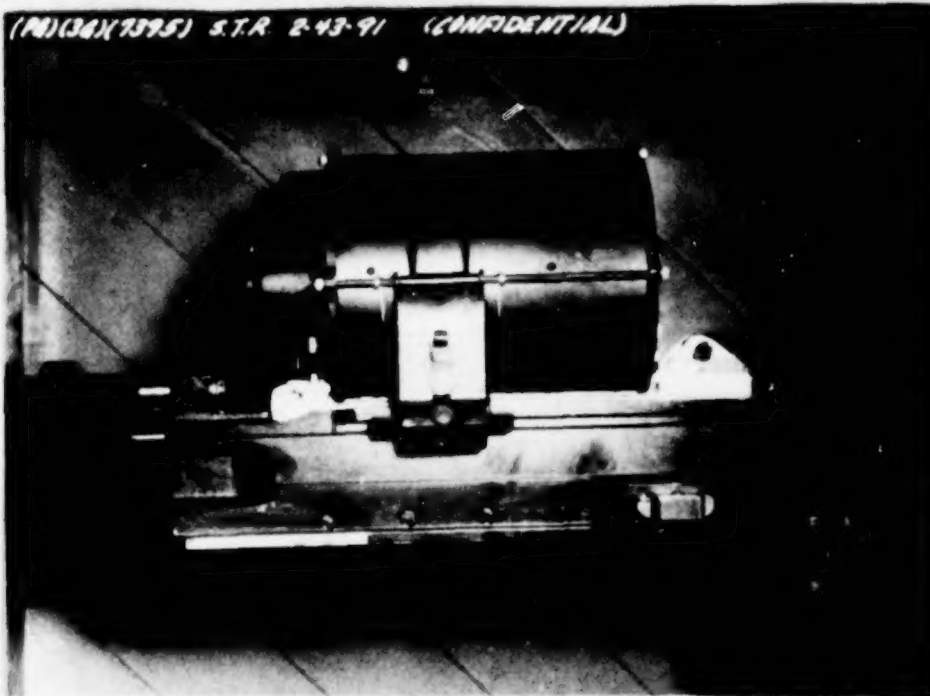
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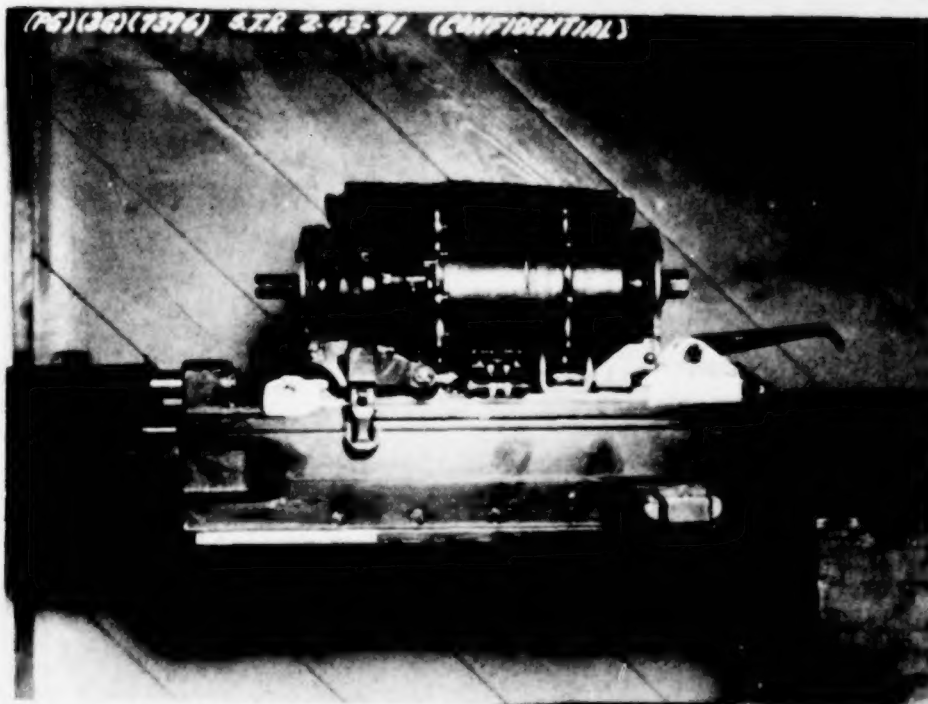
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Side view of
Standard AN-M1
feeder.

These two (2) photo-
graphs show the con-
trast in size of the
AN-M1 and T-14
feeders.

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Side view of T-14
feeder.

Inclosure 7.

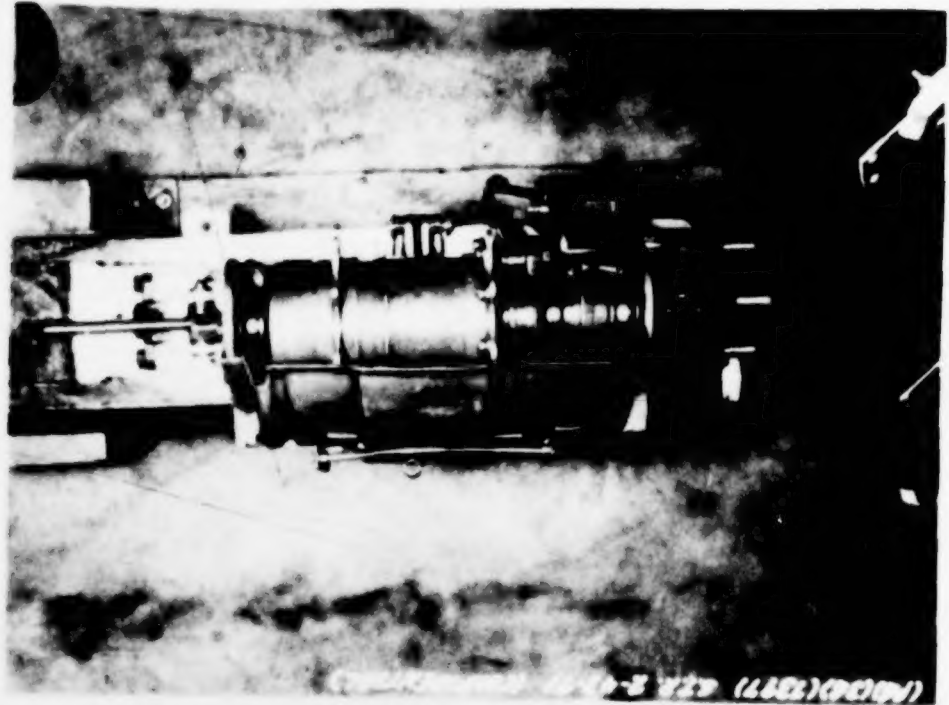
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Inlosure C.



Top view of T-14 feeder.

These two (2) photo-
graphs show the contrast
in size of the AN-M1
and T-14 feeders.



Top view of AN-M1
feeder.

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**END
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DATE:

11-94

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